Census of terns and other colonial waterbirds along the Gulf of St. Lawrence coast of New Brunswick - 2005

ANDREW W. BOYNE, BRAD E. TOMS AND JULIE MCKNIGHT

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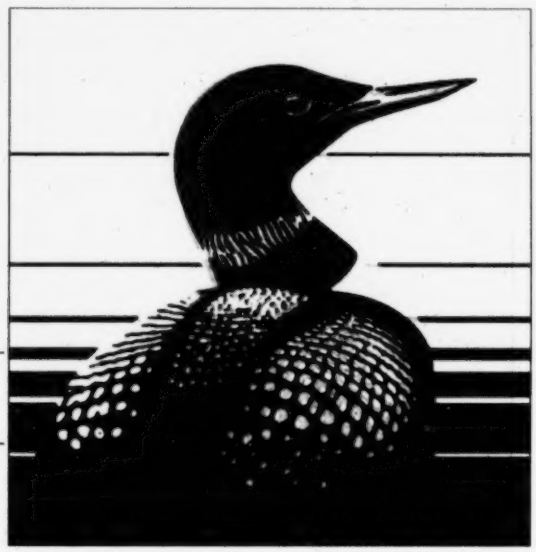

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CENSUS OF TERNS AND OTHER COLONIAL WATERBIRDS ALONG THE GULF OF ST. LAWRENCE COAST OF NEW BRUNSWICK - 2005

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Summary

Common Terns and other colonial waterbird colonies were identified during an aerial survey along the Gulf of St. Lawrence coast of New Brunswick on 25 May 2005. Ground visits to gull and tern colonies were made separately for nest counts during peak laying periods and aerial photographs were interpreted to obtain counts for gulls, Great Blue Herons, Double-crested Cormorants, and Black-legged Kittiwakes. Previous surveys of this area occurred in 1983 and 2000.

A total of 13283 tern nests were counted at seven colonies. Outside Kouchibouguac National Park (KCHNP), the number of tern nests increased from 5707 to 7263 and within the Park, the number of tern nests decreased from 6911 to 6020 since 2000. In 1983 it was estimated that 6065 pairs were nesting at 23 sites outside KCHNP and 6396 pairs were nesting within the Park. Although the number of colonies decreased, the population has rebounded to the level observed in 1983. The number of tern colonies outside KCHNP decreased from eleven to seven but the number of colonies in KCHNP increased as terns colonized a second site. Historical data suggest that only a few Arctic Terns nest along this shore so effort was not made to locate nesting Arctic Terns, although it is likely that a few pairs nested in the study area.

Ring-billed Gulls were identified at two colonies during the aerial survey with a total of 4366 pairs. Since 2000, this represents an increase of 822 pairs and a reduction in the number of colonies from six to two. Most of the recent growth was on Tern Island, Tabusintac where the number of nesting Ring-billed Gulls grew by 17% annually between 2000 and 2005. The annual growth rate between 1986 and 2005 was approximately 5%. Aerial photo interpretation estimated 1025 Great Black-backed Gulls and 2406 Herring Gull pairs at 17 and 12 sites, respectively. The populations of Great Black-backed Gulls and Herring Gulls have been stable or slightly increasing since 2000. The number of Herring Gulls is about half what it was in 1986, and the Great Black-backed Gull population is relatively unchanged since 1986.

Aerial photo interpretation indicated 5107 Double-crested Cormorant nests at 11 colonies. The tree-nesting colony on Heron Island was not included in this survey because of the difficulty of counting large tree-nesting cormorant colonies using aerial photography. Excluding the Heron Island colony, the population increased by 1992 nests between 2000 and 2005.

Black-legged Kittiwakes nested in four colonies with a total estimate of 379 nest sites. This is an increase since 2000, the first year the species was identified along this coast, when 97 nests were observed at a single colony.

Four colonies of Great Blue Herons were identified during aerial surveys in 2005 and the total number of nest was estimated to be 264. When nest numbers were compared by colony, there was a decrease of 69 nests among those four colonies since 2000. Inland colonies were missed by these aerial surveys and therefore no conclusions can be made about the regional population.

Resume

Des Sterne pierregarin et d'autres colonies coloniales de waterbird ont été identifiées pendant un aperçu aérien le long du Golfe de la côte de rue Lawrence du Nouveau Brunswick le 25 mai 2005. Des visites de la terre aux colonies de mouette et de sterne ont été faites séparément pour des comptes de nid pendant la crête étendant des périodes et des photographies aériennes ont été interprétées pour obtenir des comptes pour des mouettes, de grands hérons, des Cormoran à aigrettes, et Mouette tridactyle. Les aperçus précédents de ce secteur se sont produits en 1983 et 2000.

Un total de 13283 nids de sterne ont été comptés à sept colonies. En dehors du parc national de Kouchibouguac (KCHNP), du nombre de nids de sterne accrus de 5707 à 7263 et dans le parc, le nombre de nids de sterne a diminué de 6911 à 6020 depuis 2000. En 1983 on l'a estimé que 6065 paires nichaient à 23 emplacements en dehors de KCHNP et 6396 paires nichaient dans le parc. Bien que le nombre de colonies ait diminué, la population a rebondi au niveau observé en 1983. Le nombre de colonies KCHNP extérieur de sterne a diminué d'onze à sept mais le nombre de colonies dans KCHNP accru comme sternes a colonisé un deuxième emplacement. Les données historiques suggèrent que seulement quelques sternes arctiques nichent le long de ce rivage ainsi l'effort n'a pas été fait de localiser les sternes arctiques d'emboîtement, bien qu'il soit probable que quelques paires aient niché dans le secteur d'étude.

Goéland à bec cerclé ont été identifiées à deux colonies pendant l'aperçu aérien avec un total de 4366 paires. Depuis 2000, ceci représente une augmentation de 822 paires et une réduction du nombre de colonies de six à deux. La majeure partie de la croissance récente était sur l'île de sterne, Tabusintac où le nombre de mouettes Anneau-affichées par emboîtement s'est développé de 17% annuellement entre 2000 et 2005. Le taux de croissance annuel entre 1986 et 2005 était approximativement 5%. L'interprétation de photo aérienne a estimé 1025 grandes Goéland marin et 2406 Goéland argenté des paires à 17 et 12 emplacements, respectivement. Les populations de Goéland marin et de Goéland argenté ont été stables ou légèrement augmentantes depuis 2000. Le nombre de mouettes d'harengs est environ la moitié ce qui était il en 1986, et la grande population Noir-soutenue de mouette est relativement inchangée depuis 1986.

L'interprétation de photo aérienne a indiqué 5107 nids Cormoran à aigrettes à 11 colonies. La colonie d'arbre-emboîtement sur l'île de héron n'a pas été incluse dans cet aperçu en raison de la difficulté de compter de grandes colonies de cormoran d'arbre-emboîtement en utilisant la photographie aérienne. À l'exclusion de la colonie d'île de héron, la population a augmenté par 1992 nids entre 2000 et 2005.

Mouette tridactyle a niché dans quatre colonies avec une évaluation totale de 379 emplacements de nid. C'est une augmentation depuis 2000, la première année où les espèces ont été identifiées le long de cette côte, quand 97 nids ont été observés à une colonie simple.

Quatre colonies de grands hérons ont été identifiées pendant des aperçus aériens en 2005 et on a estimé à que tout le nombre de nid 264. Quand des nombres de nid ont été comparés par la colonie, il y avait une diminution de 69 nids parmi ces quatre colonies depuis 2000. Des colonies intérieures ont été manquées par ces aperçus aériens et donc aucune conclusion ne peut être faite au sujet de la population régionale.

Introduction

In 1999, the Canadian Wildlife Service (CWS) started a program to census tern colonies in Atlantic Canada after recognising that many tern colonies had not been surveyed in over a decade and, for some, in as many as three decades. Since 1999, all four Atlantic Provinces have been surveyed every 4-5 years. The Gulf of St. Lawrence coast of New Brunswick was surveyed in 2000 and 2005 as part of this program; surveys focussed on Common Terns (*Sterna hirundo)*, Great Black-backed Gulls (*Larus marinus*), Herring Gulls (*L. argentatus*), Ring-billed Gulls (*L. delawarensis)*, Double-crested Cormorants (*Phalacrocorax auritus*), Great Blue Herons (*Ardea herodias*) and Black-legged Kittiwakes (*Rissa tridactyla)*. Surveys in 2000 and 2005 followed identical methodology and timing reflected peak breeding periods for Ring-billed Gulls, Herring Gulls, Great Black-backed Gulls, and Common Terns.

The first comprehensive census for Common Terns along the Gulf of St. Lawrence coast of New Brunswick was conducted in 1983 (Lock et al., 1984). During that survey, Lock et al. counted 12461 Common Tern nests at 26 locations (although based on high numbers of empty nests at some colonies he estimated that 15500 pairs attempted to breed at the 26 colonies). In 2000, 12618 nests were counted at 11 colonies along this coast. Outside Kouchibouguac National Park (KCHNP), the 2000 survey showed a decline from 6065 pairs at 23 colonies in 1983 to 5707 pairs at 11 colonies (Boyne and Hudson, 2002). During that same time, the Tern Islands population in KCHNP increased from 6396 to 6911 pairs (Boyne and Hudson, 2002).

The first survey of gulls along the Gulf of St. Lawrence coast of New Brunswick was conducted in 1986 (Lock 1987). A subsequent survey in 2000 saw an increase of 2031 Ring-billed Gull nests to 3565, up from 1534 nests in 1986 (Boyne and Hudson, 2002). The 2000 survey showed a stable population of approximately 900 pairs of Great Black-backed Gulls and a decrease in the number of nesting Herring Gulls by more than 50% since 1986. Also in the 2000 survey, 97 pairs of Black-legged Kittiwakes were observed along with 3704 Double-crested Cormorants, and 647 pairs of Great Blue Herons.

Increased development and human activity along the New Brunswick coast, islands, and barrier beaches are a concern for Common Terns and other colonial waterbirds that rely on these habitats for reproduction. Another concern for these species is the threat of predators and, especially for terns, other colonial nesting species. Studies in Kouchibouguac National Park showed that colonizing Great Black-backed Gulls and Herring Gulls had a negative impact on Common Terns nesting in the park (Poussart et al. 1997) and increasing populations of Ring-billed Gulls were thought to be a threat to Common Terns because they are known to exclude terns from their nesting areas (Blokpoel et al., 1997).

This report summarizes the results of the 2005 surveys and relates the findings to data from previous surveys.

Methods

Aerial Counts

The Gulf of St. Lawrence coast of New Brunswick was surveyed in a fixed wing aircraft (Cessna 172, Tartan Air, Pilot: Mark Coffin) on 25 May 2005. The survey was timed to correspond with the third week of incubation of Great Black-backed Gulls and the second week of incubation for Herring Gulls. Although Common Terns had not begun to nest at the time of the survey, they were observed and recorded at colony sites to determine locations for ground surveys. Surveys in 2000 and 2005 followed identical methodology and timing reflected peak breeding periods for Ring-billed Gulls, Herring Gulls, Great Black-backed Gulls, and Common Terns.

CWS coastal blocks 331-362 (Lock et al., 1996) were surveyed at 250-320m by two observers (A.W. Boyne and J. McKnight) sitting on the same side of the aircraft (Figure 1). The northern coast of New Brunswick was flown from East to West from Baie Vert (45.9915, -63.9453) to Dalhousie (48.0619, -66.4706). Total flight time was 5.5 hours. All potential sites were surveyed regardless of previous presence of breeding seabirds. During the surveys, digital photos were taken from the plane of gull, cormorant, heron, and kittiwake colonies using a Nikon D2x digital camera with a 12.8 megapixel resolution. Photos were taken on an angle from the window of the plane because absolutely vertical photos were not possible due to the position of the landing gear. Colonies were marked as a waypoint using a global positioning system (model- Garmin GPS 76) and a written recording of location was taken for each colony. In most cases, each observer made an independent estimate of the number of individuals within the colony and the two observers mutually decided on an estimate of the species ratio of Great Black-backed Gulls and Herring Gulls. In one occurrence, one observer estimated Ring-billed Gulls while the other estimated Herring Gulls due to logistics. Tern colonies were noted wherever present, but no attempt was made to estimate colony size.

Individuals that were obviously loafing or observed in the intertidal zone were not counted. On islands with small gull colonies, total counts of individual gulls were performed; but at larger colonies, birds were counted in clusters of 5, 10 or 25.
The large size of Double-crested Cormorant and Great Blue Heron nests made it possible to identify apparently occupied nest sites from the air, while for gulls it was only possible to identify apparently occupied territories (i.e., individuals or pairs spaced appropriately suggesting they are occupying a territory) from the air.

Ground Counts

Ground censuses were conducted 30 May to 2 June for gulls and 13-19 June for Common Terns. Unlike the 2000 survey in New Brunswick, gulls were surveyed earlier than terns to coincide with the last week of incubation. Tern surveys commenced one week later

than in 2000 to ensure that peak laying was completed. Each census was undertaken by two to five researchers with the exception of one tern colony that was surveyed by two groups of four and five people, respectively at the same time due to its large size. Researchers walked parallel transects at about an arms length from each other. The outside line of each transect was flagged with standard forestry flags and each nest was marked with a wooden stir stick to avoid double counting. The flags were picked up during the census of the next transect. The tern census in KCHNP was conducted by KCHNP staff and the data were provided to us by the park. Clutch size data were not available for these colonies.

The number of eggs in each nest was recorded and, in the case of colonies with multiple species, the species occupying the nest was determined by a combination of egg size, nest location, direct observation of incubating birds, and hatching chronology. In cases where chicks had wandered too far from their nest to be obviously associated with a nest, the chick was recorded separately as a chick without an association to a nest. This did not allow us to determine clutch sizes for those nests, but did allow calculation of percent hatch for the colony. Problems associating chicks with nests only occurred for gull colonies.

Most ground-nesting cormorants were located near gull colonies and we chose not to disturb these birds due to the increased risk of egg predation by gulls.

Photo Counts

Aerial photographs of gull colonies were digitally interpreted using methods described in Boyne and Hudson (2002). In that survey, photos were taken using conventional film and were professionally scanned and saved to compact discs. Pictures taken during this survey were taken with a Nikon D2x 12.8 mega pixel digital camera and the images were downloaded from the camera to a 250GB external hard-drive (Accomdata™ 250GB). Photos were then interpreted using Adobe® Photoshop® 5.5. Where islands or colonies could not be captured in a single photograph, a series of photos were stitched together in Photoshop® to produce a composite image of the entire colony.

If adjacent images did not line up exactly, individuals that appeared twice were erased from the photos to avoid double counting. In the case of dense colonies, a line was drawn using landmarks and individuals were counted on opposite sides of the lines on the two photographs so that no territorial individuals (gulls) or apparently occupied nest sites (herons, cormorants, and kittiwakes) were counted twice. Each image was flattened into a single layer and the canvas size was reduced to the edges of the image in order to reduce the file size. In order to reduce file size, large areas of the photograph that had no breeding birds (e.g. water) were erased.

In Photoshop®, the composite image of a colony or the single image of an island was interpreted by marking targets (territorial individuals, apparently occupied sites) with a square array of pixels of a known size (e.g. 3x3 pixels). This was accomplished by

opening a blank layer for each species present in the colony and using the Photoshop® pencil tool and a square pencil to mark targets which we considered equivalent to pairs. The marks were made using a pure colour (e.g. pure red, pure yellow) in order to avoid any confusion when analyzing the number of pixels and a different colour was used for each species. Similar to the aerial estimates, birds that were loafing or observed in the intertidal zone in the photos were not marked and birds that appeared to be paired were marked only once. When all individuals or pairs appeared to be marked, the layer used for marking was made visible with all other layers hidden and the 'histogram' function was used in order to obtain a total number of pixels. This was repeated for each layer. The number of individuals was calculated by dividing the total number of pixels by the number of pixels in each square covering a target. Apparently occupied nest sites for Black-legged Kittiwakes and cliff-nesting cormorants were identified in photos by the presence of a bird on the cliff with white feces below the bird

Corrections were made for the ground surveys that were started but not completed due to excessive disturbance, or time limitations. This was undertaken for one tern colony, and two gull colonies. Corrections were not made to other incomplete surveys which counted peripheral individuals during focused surveys for another species (i.e., counting Great Black-backed Gulls while surveying Ring-billed Gulls). The area that was surveyed was delineated on the aerial photos using notes made during the ground surveys. A correction factor was calculated and applied to the remainder of the total aerial photo estimates. The corrected value for the unsurveyed area was then added to the ground count of the surveyed area (Equation 1).

Equation 1:

$$\text{Corrected Estimate} = \left[\frac{\text{(Total Photo Estimate – Photo Estimate of Area Surveyed by ground)}}{\text{(Photo Estimate of Area Surveyed by ground/ Incomplete Ground Count)}} \right] + \text{Incomplete Ground Count}$$

Aerial photo estimates of gull colonies were corrected by calculating the ratio of apparently occupied nest sites or territories to nests counted on the ground and applying that correction factor to the photo estimates. Aerial estimates and aerial photo estimates were corrected by dividing by the associated correction factor. Correction factors were calculated for photo counts and for aerial observers to determine which method better reflected the true population size and to determine if ground counts could be eliminated in the future with the use of correction factors.

Results and Discussion

Common Terns

Aerial surveys identified ten sites where Common Terns were potentially breeding, two of which were in Kouchibouguac National Park (Figure 2). The absence of Common Terns was noted during ground surveys at one of the nine sites (unnamed island north of Crab Island, 47.292, -64.954) thought occupied during aerial surveys. Individuals observed on that island during aerial surveys and gull ground surveys were either loafers from the nearby colony of Tern Island, Tabusintac or a colony that abandoned the site. Breeding was confirmed during ground surveys and 7263 tern nests were counted at seven colonies by CWS staff and 6020 nests were counted at two colonies in KCHNP by Parks Canada staff (Table 2). The Tern Islands (1, 2, and 3) in Kouchibouguac were considered one colony. The total number of Common Tern nests along this coast was 13283. The average clutch size at colonies outside KCHNP was 2.58 ±0.63 eggs per nests (range = 2.00 - 2.85) (Table 1).

Since 2000, the number of Common Tern nests along the Gulf of St. Lawrence coast of New Brunswick increased from 12618 to 13283 (Table 2). In 2000, only two colonies had greater than 2000 nests, but in 2005, three colonies had more than 2000 nests and two had close to 1000 nests (Table 2). In 2000, two colonies were surveyed on 8 June and 9 June and it was felt that the survey took place before peak laying. The 2005 survey occurred between 13 and 19 June, which was similar to the timing of the rest of the 2000 ground surveys. Based on clutch sizes and the proportion of empty nests, the 2005 survey appeared to take place closer to peak laying.

Historical data suggest that a only a very small number of Arctic Terns (*S. paradisaea)* nest among Common Terns along the Gulf of St. Lawrence coast of New Brunswick. For this reason minimal effort was made to determine the proportion of Arctic Terns in colonies. One dead Arctic Tern adult was positively identified during the survey of Tern Island, Tabusintac. Despite this finding, it is still assumed that only a small number of Arctic Terns nest along this coast among the more numerous Common Terns.

Tern Islands, KCHNP is the only managed tern colony along the Gulf of St. Lawrence coast of New Brunswick and it supported more than half of the tern nests along that coast in 2000. In 2005, the number of Common Terns nesting in KCHNP decreased from 6911 nests to 6020 nests, but the birds were spread across two colonies. Outside of KCHNP, the number of tern nests increased from 5707 to 7263 (5% annual growth between 2000 and 2005). A 1983 survey found 6065 pairs nesting at 23 sites (Lock et al., 1984) outside of KCHNP on the Gulf of St. Lawrence coast. Although the number of colonies has declined, the population is now larger than the 1983 estimate.

Boyne and Hudson (2002) were concerned that the two tern colonies south of KCHNP supported less than 25 pairs in 2000, which was a major decline from the 1983 surveys that found six colonies supporting over 300 pairs (Lock et al., 1984). The 2005 survey

also only found two colonies south of KCHNP, but these supported 129 nests, with 121 nests at Shediac Bay Yacht Club. The observed increase since 2000 may only be temporary, however, because the managers of the Shediac Bay Yacht Club are working to make the sunken barge that offered habitat to breeding Common Terns unsuitable for nesting to reduce interactions with humans (i.e., dive-bombing boaters).

Ring-billed Gulls

Ring-billed Gulls were identified at two colonies during aerial surveys in 2005 and both sites were visited during ground surveys (Figure 3). The aerial visual estimate for the two colonies were 2000 for Tracadie Sand Spit and 1900 for Tern Island. The total number of apparently occupied territories identified on aerial photos was 3947, and during ground counts, 4367 nests were counted at these two sites (Table 3). The mean clutch size was 2.71 ± 0.61 and at the time of the survey, 1% of the eggs had hatched (Table 3). On Tern Island, Tabusintac the colony was separated into two sub-colonies that were less than 100m apart.

The number of Ring-billed Gull colonies declined from six in 2000 to two in 2005 (Table 4). Despite this decline, the overall number of apparently occupied nest sites of Ring-billed Gulls estimated from aerial photos increased by 403, from 3544 in 2000 to 3947 in 2005. Comparisons of ground counts could not be done because ground counts were not conducted in 2000.

In 2005, Bathurst Harbour Island # 3 (47.633, -65.647) was observed from a boat during ground surveys of gulls and this visit confirmed the absence of Ring-billed Gulls as indicated by the aerial survey. The absence of nesting Ring-billed Gulls was also confirmed by air at Maisonette Dune, Fox Dens Beach, and Heron Island. Only half of Fox Dens beach was visited from the ground, but the incomplete ground survey and the aerial surveys indicated that Ring-billed Gulls were not nesting there. Other gulls were breeding at the sites where Ring-billed Gulls had nested in 2000 so competition for resources could be a factor in the reduction of breeding sites.

A survey in 1986 found 1534 Ring-billed Gull nests (Lock, 1987). Over the 14-year period between the 1986 and 2000 surveys, there was an average annual population growth of 6%. Between 1986 and 2005, the population of Ring-billed Gulls underwent an average annual growth rate of 5%. Comparison of aerial photo estimates from 2000 and 2005 indicate an annual growth rate of 2%. However, the Ring-billed Gull colony on Tern Island, Tabusintac increased at a growth rate of 17% per year since the 2000 survey, from 843 nests to 1900 nests (aerial visual estimates).

Herring and Great Black-backed Gulls

Herring Gulls were observed nesting at 11 sites in 2005 (Figure 4). Aerial photo interpretation estimated 2406 Herring Gull nests (Table 5). Ground counts at seven of those sites estimated a total of 241 Herring Gull nests (Table 6). The mean clutch size of Herring Gulls was 2.09 ± 0.63 (range: 1.00 - 2.75) and 1% of the eggs had hatched at the time of the survey (Table 6).

Great Black-backed Gulls were identified nesting at 16 sites in 2005 (Figure 5). The total number of apparently occupied Great Black-backed Gull territories estimated from aerial photos was 1025 (Table 5). Ground counts at nine sites found 329 nests; the largest colony occurred at Fox Dens Beach and the smallest colony that was completely surveyed had 20 nests (Tern Island, Tabusintac and Tracadie Spit Tip had fewer nests but the surveys were incomplete; Table 7). The mean clutch size for Great Black-backed Gull nests was 2.35 ± 0.72, and 29% of eggs had hatched at the time of the survey, suggesting that incubation was nearing completion for most pairs (Table 7).

To obtain more precise estimates of the number of gull nests, we derived correction factors for estimates derived from aerial surveys alone using colonies where we conducted both ground counts and aerial surveys (Table 8). This method is more precise than using correction factors from other surveys undertaken at different times and under different conditions. The photo counts were more precise than the observer counts and, therefore, were chosen as the variable for the correction factor. This is consistent with surveys in Prince Edward Island in 2004 (Boyne and McKnight 2005).

Seven colonies were surveyed using aerial photo estimates and ground counts and produced an average correction factor of 1.57 ± 0.58 (Table 8). Thus, the corrected estimates based on 2005 surveys were1532 Herring Gull pairs [1119-2430] and 652 [477-1035] Great Black-backed Gull pairs (Table 5).

A correction factor was used in the 2000 survey based on Lock (1987), but was not calculated using ground counts from the same year (Boyne and Hudson 2002). As a result, the corrected estimates are not comparable because they use different methods to derive correction factors. Instead, we compared the uncorrected photo estimates from the 2000 survey (2330 Herring Gulls and 910 Great Black-backed Gulls) to the uncorrected aerial photo estimates from 2005 (2406 Herring Gulls and 1025 Great Black-back Gulls). Based on these results, it appears that populations of Great Black-backed Gulls and Herring Gulls have been stable or slightly increasing since 2000.

Double-crested Cormorants

Twelve cormorant colonies were identified during the aerial survey conducted on 25 May (Figure 6). Of these, seven were ground-nesting colonies, three were cliff-nesting colonies, and two were tree-nesting colonies (Table 9). Heron Island (a tree nesting

colony) was not surveyed because of the inaccuracies involved when estimating large tree-nesting colonies using aerial photography. Fleming Island was estimated using aerial photography because it was a small tree nesting colony and therefore relatively easy to count with accuracy. Only one ground survey was done for these eleven colonies (Richibucto Harbour), where 21 nests were counted (Table 9). The total number of apparently occupied nest sites was 5107 (Table 9).

The 2000 survey found cormorants at ten colonies with a total of 3704 apparently occupied nest sites, although the large tree-nesting colony on Heron Island was thought to be vastly underestimated. We have observed an apparent increase in cormorant nest numbers along the Gulf of St. Lawrence coast of New Brunswick from 3115 (not including Heron island estimate) to 5107 between 2000 and 2005. The largest increase was on Egg Island, which grew by 1292 nests (132%). Four other colonies increased by more than 100 nests since 2000. Declines were seen on Pokeshaw Island, Cap Pele (47.819, -65.162), and New Bandon since 2000 and their decreases were possibly a result of emigration to the nearby colony at Clifton, which grew by 199 nests. The overall annual growth rate of the cormorant population (excluding Heron Island) between 2000 and 2005 was approximately 10% per year. Eight colonies were surveyed in both 2000 and 2005. The other four colonies were new to us in 2005.

Black-legged Kittiwakes

During aerial surveys, four Black-legged Kittiwake colonies were identified and photographed (Figure 7). Two of those colonies were near cliff-nesting Double-crested Cormorant colonies. The smallest colony had six nest sites (Pokeshaw) and the largest (Cap Pele) was estimated to have 166. The total number of kittiwake nest sites estimated from aerial photos was 379 (Table 10).

The 2000 survey found one colony of kittiwakes east of Grindstone Point with an estimated 97 apparently occupied nest sites present among a cliff-nesting cormorant colony. This colony was the first nesting record for the species in northern New Brunswick. Since 2000, the population has increased by 282 nest sites at four sites along the cliffs (Table 10). One colony (Cap Pele) was visited during ground surveys on 1 June and the presence of nests was confirmed. Since the 2000 survey, the number of kittiwakes nesting in northern New Brunswick has risen by 31% per year.

Great Blue Herons

Four colonies of Great Blue Herons were identified during aerial surveys in 2005 (Figure 8). The largest colony was Caraquet with 107 apparently occupied nest sites. The total number of nest sites was estimated to be 264 (Table 11). A separate ground survey found 181 apparently occupied Great Blue Heron nest sites on Bay du Vin Island (Mackinnon et al., 2005), whereas only 105 were estimated from aerial photos (Table 11). This suggests that aerial photo estimates likely underestimated the size of Great Blue Heron colonies.

Between 2000 and 2005, declines were observed at three colonies (Shediac Island, Inkerman and Bay du Vin) and numbers at Caraquet Island increased. Overall, the number of Great Blue Herons at the four colonies surveyed in 2005 declined by 161 nest sites. As the 2005 survey did not specifically target Great Blue Herons, inland colonies were missed by aerial surveys, and therefore conclusions can only be made at the colony level.

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Literature Cited

Boyne, A.W. and J.K. Hudson. 2002. Census of terns and other colonial waterbirds along the Gulf of St. Lawrence coast of New Brunswick- 2000. Technical Report Series No. 397. Canadian Wildlife Service, Atlantic Region. 29pp.

Boyne, A.W., and J. McKnight. 2005. Census of terns and gulls in Prince Edward Island-2004. Technical Report Series No 428. Canadian Wildlife Service, Atlantic Region. 29pp.

Blokpoel, H., Tessier, G.D and Andress, R. A. 1997. Successful restoration of the ICE Island Common Tern colony requires on-going control of Ring-Billed Gulls. Colonial Waterbirds 20:98-101.

Lock, A. R., J. P. Sircom and S. H. Gerriets. 1996. Coastal waterbirds in Atlantic Canada. Canadian Wildlife Service – Atlantic Canada, Environment Canada.

Lock, A. R. 1987. A census of gull colonies in northern New Brunswick-1986. Unpublished report. Canadian Wildlife Service, Dartmouth, Nova Scotia.

Lock, A. R., T. Currie and M. Malone. 1984. Tern colony surveys in New Brunswick 1983. Canadian Wildlife Service, Dartmouth, Nova Scotia. 14pp.

Mackinnon, C.M., A.C. Kennedy, A.A., Campbell, R. Steeves. 2005. Great Blue Heron (*Ardea herodias*) census (2005) and evaluation of habitat use, Bay du Vin Island New Brunswick. Unpublished Report. Canadian Wildlife Service, Sackville, New Brunswick.

Poussart, C., I. Robichaud, E. Tremblay and S.G. Reebs. 1997. Impact of sea gull presence on the reproductive success and vigilance behaviour of Common Terns in Kouchibouguac National Park, New Brunswick. 8. Parks Canada, Atlantic Region.

Table 1. Clutch sizes of Common Tern colonies surveyed along the Gulf of St. Lawrence coast of New Brunswick, 2005.

Location	Latitude	Longitude[1]	Date	Clutch size (eggs)						Total nests with eggs	Total eggs	Mean clutch size
				0	1	2	3	4	5			
Shediac Bay Yacht Club	46.227	-64.545	13 June	1	11	18	92	0	0	121	323	2.67
Unnamed Island # 2 in Richibucto Harbour	46.688	-64.855	13 June	0	2	4	2	0	0	8	16	2.00
Tern Island, Tabusintac	47.317	-64.929	14 June	4	290	1073	2085	15	0	3463	8751	2.53
Unnamed Island # 1 in Pokemouche Bay	47.662	-64.793	15 June	0	7	12	144	2	0	165	471	2.85
Unnamed Island # 2 in Pokemouche Bay	47.659	-64.794	15 June	0	28	43	393	1	0	465	1297	2.79
Fox Dens Beach	47.899	-64.499	15 June	0	81	268	531	0	0	880	2210	2.51
Tracadie	47.533	-64.882	19 June	0	116	486	1544	13	2	2161	5782	2.68

[1] Negative latitude refers to location west of the prime meridian

Table 2. Size and location of Common Tern colonies surveyed by ground along the Gulf of St. Lawrence coast of New Brunswick, 2000 and 2005.

Location	Latitude	Longitude	Nests	
			2000	2005
Shediac Bay Yacht Club	46.227	-64.545	2	121
Unnamed Island # 2 in Richibucto Harbour	46.688	-64.855	0	8
Tern Island, Tabusintac	47.317	-64.929	2607	3463
Unnamed Island in Pokemouche Bay # 1	47.662	-64.793	0	165
Unnamed Island # 2 in Pokemouche Bay	47.659	-64.794	0	465
Fox Dens Beach	47.899	-64.499	678	880
Tracadie	47.533	-64.882	0	2161
Tern Islands (1,2,3), KCHNP	46.776	-64.874	6911	5034
North Beach, KCHNP	46.834	-64.910	0	986
Neguac North Spit	47.257	-65.000	601	0
Unnamed Island North of Crab Island	47.292	-64.9504	546	0
Grande Anse Unnamed	47.670	-64.777	656	0
Caraquet Island	47.824	-64.885	128	0
Maisonette Dune	47.815	-64.964	180	0
Bathurst Harbour Island 3	47.633	-65.647	240	0
Dalhousie (Bowater Jetty)	48.069	-66.382	69	0
		Totals	12618	13283
		Number of colonies	11	9

Table 3. Clutch size of Ring-billed Gull nests observed during ground counts at colonies along the Gulf of St. Lawrence coast of New Brunswick, 2005.

Location	Date	Active Nests	Number of Eggs	Number of Chicks	Percent hatch	Mean clutch size	Standard deviation
Tern Island, Tabusintac	31 May	2137	5807	71	1.20	2.72	0.58
Tracadie	16 June	2229	5991	87	1.43	2.69	0.63
	Totals	4367	11798	158	1.32	2.71	0.61

Table 4. Ring-billed Gull nest counts of colonies surveyed along the Gulf of St. Lawrence Coast of New Brunswick, 2000 and 2005.

Location	Latitude	Longitude	2000		2005	
			Method[1]	Nests	Method[1]	Nests
Fox Dens Beach	47.899	-64.499	GC	262	GC	0
Maisonette Dune	47.815	-64.964	APE	268	APE	0
Tracadie	47.309	-64.941	APE	2109	GC	2229
Tern Island, Tabusintac	47.317	-64.929	APE	843	GC	2137
Bathurst Harbour Island # 3	47.633	-65.647	GC	6	GC	0
Heron Island	48.000	-66.162	APE	56	APE	0
			Total	3544		4367
			Colonies	6		2

[1]APE = Aerial Photo Estimate, GC = Ground Count

Table 5. Estimates from aerial photos of apparently occupied territories at Herring Gull (HERG) and Great Black-backed Gull (GBBG) colonies along the Gulf of St. Lawrence coast of New Brunswick, 2005.

Location	Latitude	Longitude	Number of Apparently Occupied Territories		
			HERG	GBBG	Total
Bathurst Harbour Island # 3	47.633	-65.647	186	39	225
Bathurst Harbour Island # 2	47.632	-65.647	68	55	123
Egg Island	47.105	-65.047	52	142	194
Maisonette Dune	47.815	-64.964	198	37	235
Fox Dens Beach	47.899	-64.499	937	175	1112
Pokeshaw	47.789	-65.256	0	3	3
Richibucto Harbour	46.688	-64.855	0	52	52
Tern Island, Tabusintac	47.317	-64.929	0	12	12
Tracadie	47.514	-64.908	304	46	350
Tracadie Spit Tip	47.552	-64.868	0	58	58
Neguac Bar	47.225	-65.020	592	101	693
Crab Island, Unnamed Island North of	47.292	-64.954	0	57	57
Crab Island, Near Neguac	47.273	-64.966	4	69	73
Unnamed Island W of Tracadie S. Beach,	47.309	-64.941	29	155	184
Unnamed island # 1 in Pokemouche Bay	47.662	-64.793	27	21	48
Fleming Island	47.976	-66.183	9	3	12
		Total	2406	1025	3431
		Colonies	11	16	16

Table 6. Ground counts of Herring Gull nests, eggs and chicks on the Gulf of St. Lawrence coast of New Brunswick, 2005.

Location	Date	Active Nests	Eggs	Chicks	Percent Hatch (eggs)	Mean Clutch Size	Standard Deviation
Richibucto Harbour	30 May	2	4	0	0.00	2.00	1.00
Tern Island, Tabusintac[1]	31 May	1	1	0	0.00	1.00	0.00
Pokemouche, Unnamed Island # 1 in	31 May	14	38	0	0.00	2.71	0.59
Unnamed Island W of Tracadie S. Beach,	1 June	7	17	0	0.00	2.43	0.90
Bathurst Harbour Island # 1	1 June	11	19	0	0.00	1.73	0.45
Crab Island, Near Neguac	2 June	4	8	0	0.00	2.00	1.00
Fox Dens Beach[1]	2 June	202	555	6	1.06	2.75	0.65
	Total	241	642	6	0.93	2.09	0.63

[1] Incomplete ground survey

Table 7. Ground counts of Great Black-backed Gull nests, eggs and chicks on the Gulf of St. Lawrence coast of New Brunswick, 2005.

Location	Date	Active Nests	Eggs	Chicks	Percent Hatch (eggs)	Mean Clutch Size	Standard Deviation
Richibucto Harbour, unnamed island # 1	30 May	29	55	13	23	1.90	0.77
Egg Island	31 May	46	113	60	53	2.46	0.7
Tern Island, Tabusintac[1]	31 May	1	3	1	33	3.00	0
Pokemouche Bay, unnamed island # 1 in	31 May	20	54	6	11	2.70	0.57
Tracadie Sand Spit[1]	1 June	9	26	0	0	2.89	0.33
Bathurst Harbour Island # 3	1 June	69	90	44	49	1.30	0.78
Fox Dens Beach	2 June	83	215	74	34	2.59	0.66
Crab Island, Unnamed Island North of	2 June	35	77	52	68	2.20	0.76
Crab Island, near Neguac	2 June	37	79	42	53	2.14	0.82
	Total	329	712	292	36	2.35	0.72

[1] Incomplete surveys

Table 8. Correction factors for gull colonies surveyed along the Gulf of St. Lawrence coast of New Brunswick, 2005.

Location			Estimates				Correction factors		
	Latitude	Longitude	Ground count (nests)	Aerial photo estimate (territories)	Aerial visual estimate observer 1 (territories)	Aerial visual estimate observer 2 (territories)	Photo estimate/ Ground count	Obs.1/ Ground count	Obs. 2/ Ground count
Richibucto Harbour	46.688	-64.855	31	52	-	-	1.68	-	-
Tracadie	47.514	-64.908	2229	2153	-	2000	0.96		0.90
Bathurst Harbour Island #1	47.649	-65.626	85	225	150	120	2.65	1.76	1.41
Fox Dens Beach	47.899	-64.499	986*	1191	425	650	1.21	1.47	2.25
Crab Island, Near Neguac	47.273	-64.966	36	57	50	55	1.58	1.39	1.53
Unnamed Island N. of Crab Island	47.292	-64.954	35	74	85	70	2.11	2.43	2.00
Egg island	47.105	-65.047	198*	194	240	165	0.98	1.21	0.83
Unnamed Island #1 in Pokemouche Bay	47.662	-64.793	34	48	50	20	1.41	1.47	0.59
*Corrected because the ground survey was not complete						n	8	6	7
						Mean	1.57	1.52	1.28
						Standard Deviation	0.58	0.48	0.61
						Confidence Interval (95%)	0.40	0.36	0.43

Table 9. Estimates from aerial photos of apparently occupied nest sites at Double-crested Cormorant colonies along the Gulf of St. Lawrence coast of New Brunswick, 2005.

Location	Latitude	Longitude	Date surveyed 2005	Nesting habitat	Number of apparently occupied nest sites 2000	Number of apparently occupied nest sites 2005
Bathurst Harbour Island # 1	47.649	-65.626	25 May	Ground	0	171
Bon Ami Rocks	48.056	-66.347	25 May	Ground	287	465
Clifton	47.729	-65.392	25 May	Cliff	19	218
Egg Island	47.105	-65.047	25 May	Ground	974	2266
Grindstone Point	47.756	-65.359	25 May	Cliff	573	21
Maisonette Dune	47.815	-64.964	25 May	Ground	10	985
New Bandon	47.733	-65.382	25 May	Cliff	619	41
Pokeshaw	47.789	-65.256	25 May	Ground	619	486
Richibucto Harbour	46.688	-64.855	25 May	Ground	0	21
Unnamed Island W of Tracadie S. Beach	47.309	-64.941	25 May	Ground	0	423
Fleming Island	47.976	-66.182	25 May	Trees	14	10
Heron Island	48.000	-66.163	25 May	Trees	589	Not estimated
				Total		5107

Table 10. Estimates from aerial photos of apparently occupied nest sites at Black-legged Kittiwake colonies along the Gulf of St. Lawrence coast in New Brunswick, 2005.

Location	Latitude	Longitude	Date surveyed	Apparently occupied nest sites
Grindstone Point	47.756	-65.358	25 May	59
Cap Pele	47.819	-65.162	25 May	166
New Bandon	47.733	-65.382	25 May	148
Pokeshaw	47.789	-65.256	25 May	6
			Total	379

Table 11. Estimates from aerial photos of apparently occupied nest sites at Great Blue Heron colonies along the Gulf of St. Lawrence coast of New Brunswick, 2005.

Location	Latitude	Longitude	Date surveyed	Apparently occupied nest sites
Bay du Vin	47.092	-65.101	25 May	105
Inkerman	47.672	-64. 831	25 May	19
Shediac Island	46.265	-64.540	25 May	33
Caraquet Island	47.824	-64.885	25 May	107
			Total	264

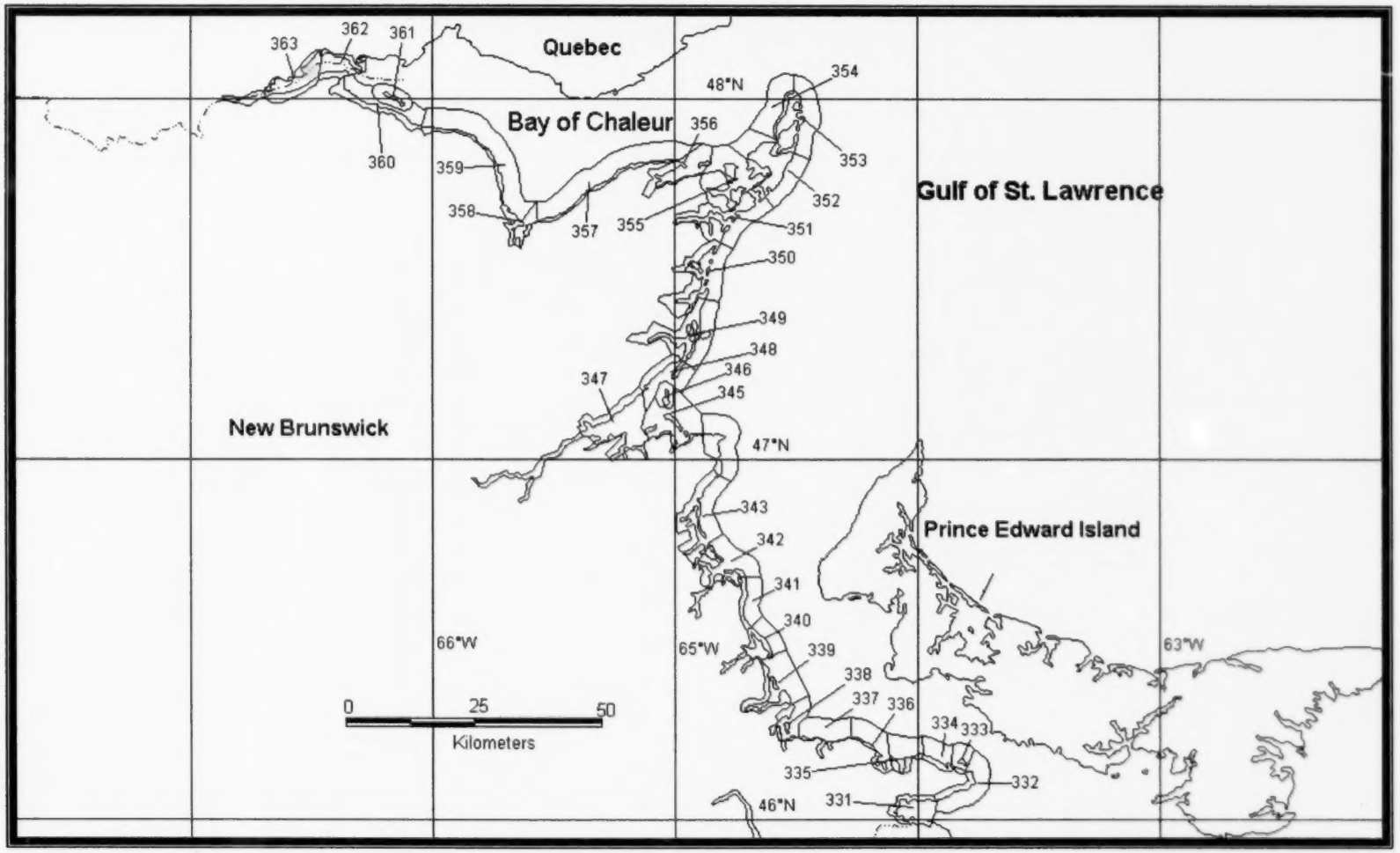

Figure 1. Extent of colonial water bird surveys along the Gulf of St. Lawrence coast, New Brunswick, Canada, conducted on 25 May 2005 (Coastal Survey Blocks, 331-364. Lock et al., 1996).

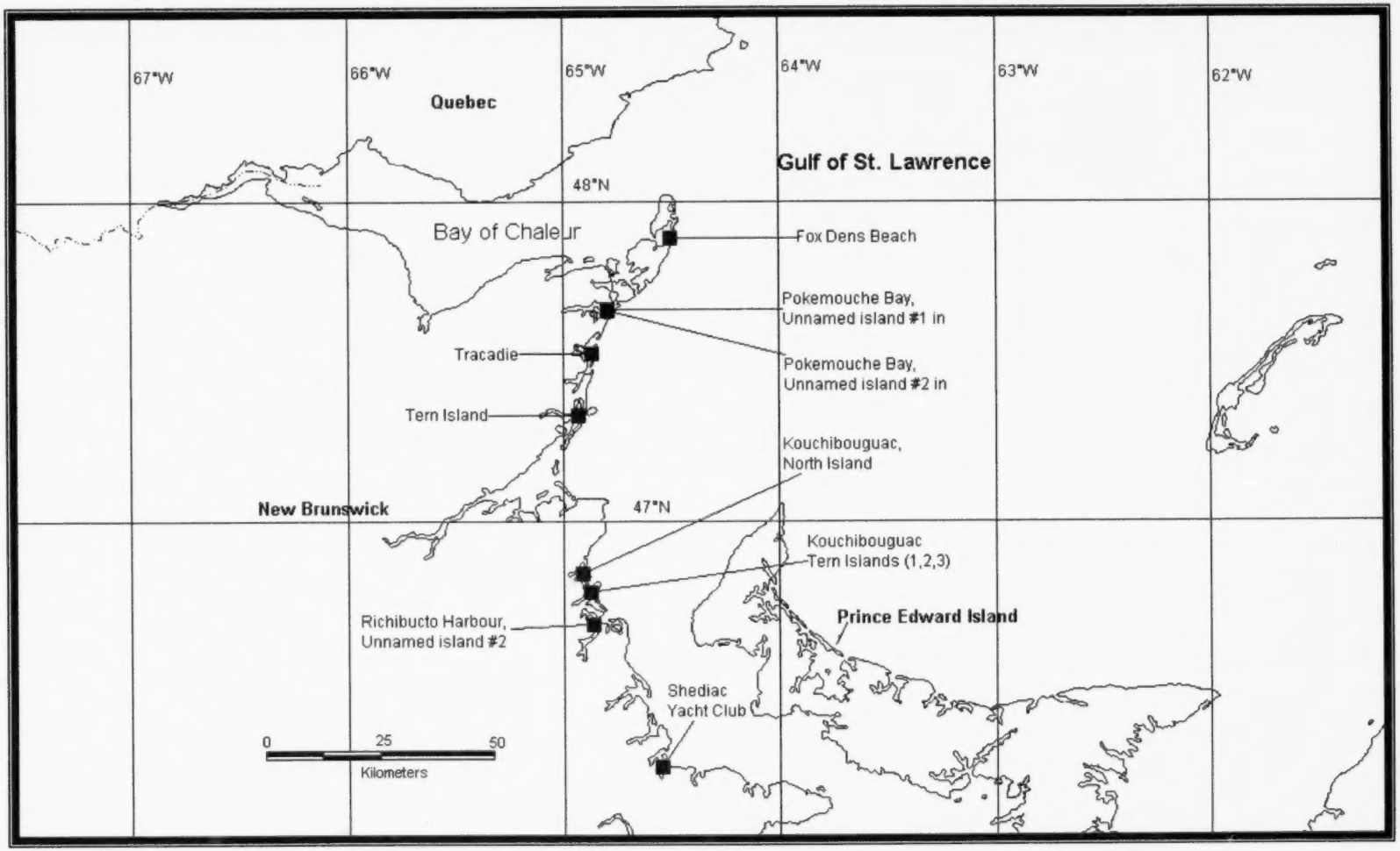

Figure 2. Location of Common Tern colonies surveyed along the Gulf of St. Lawrence coast of New Brunswick, 2005.

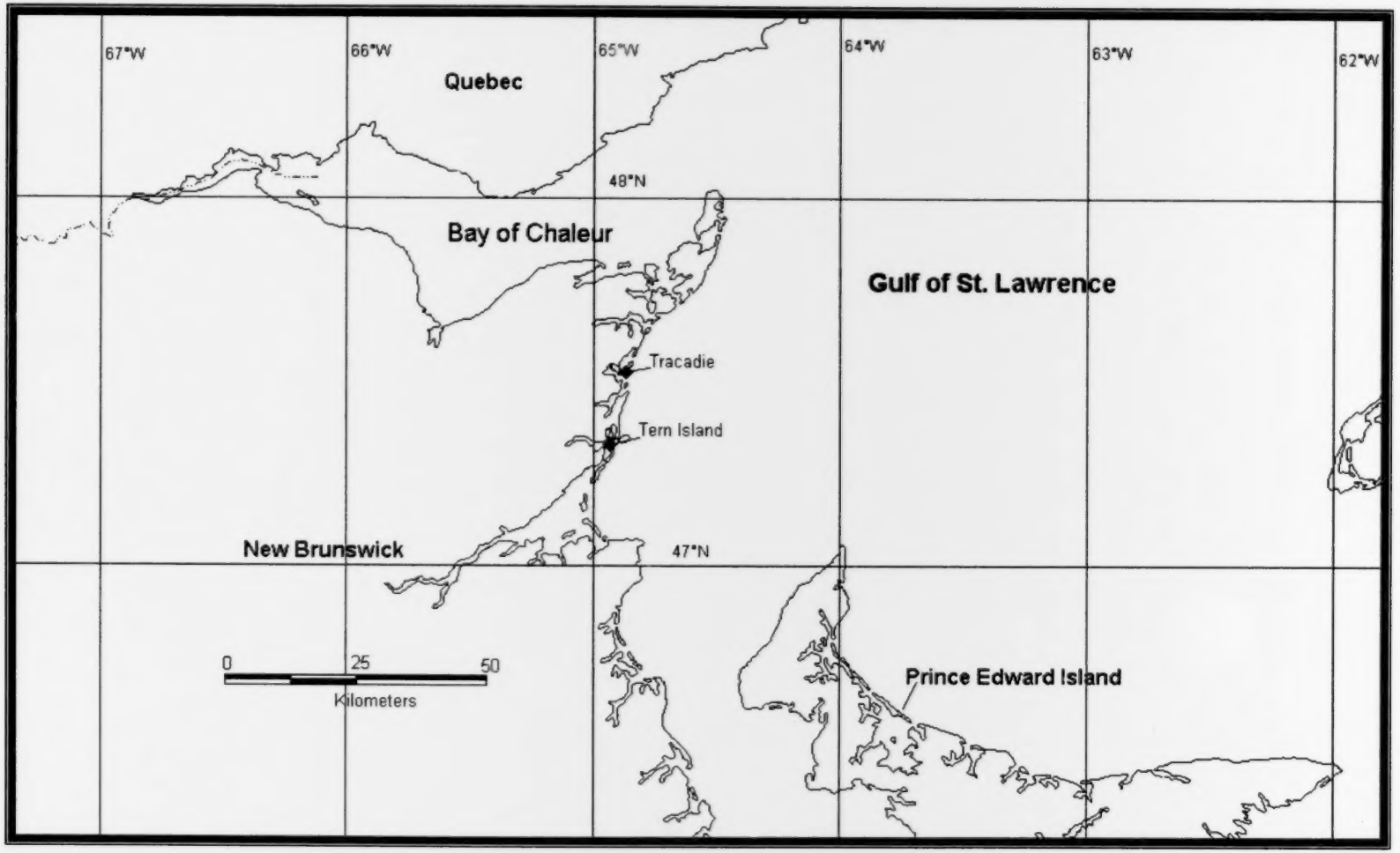

Figure 3. Location of Ring-billed Gull colonies surveyed along the Gulf of St. Lawrence of New Brunswick, 2005.

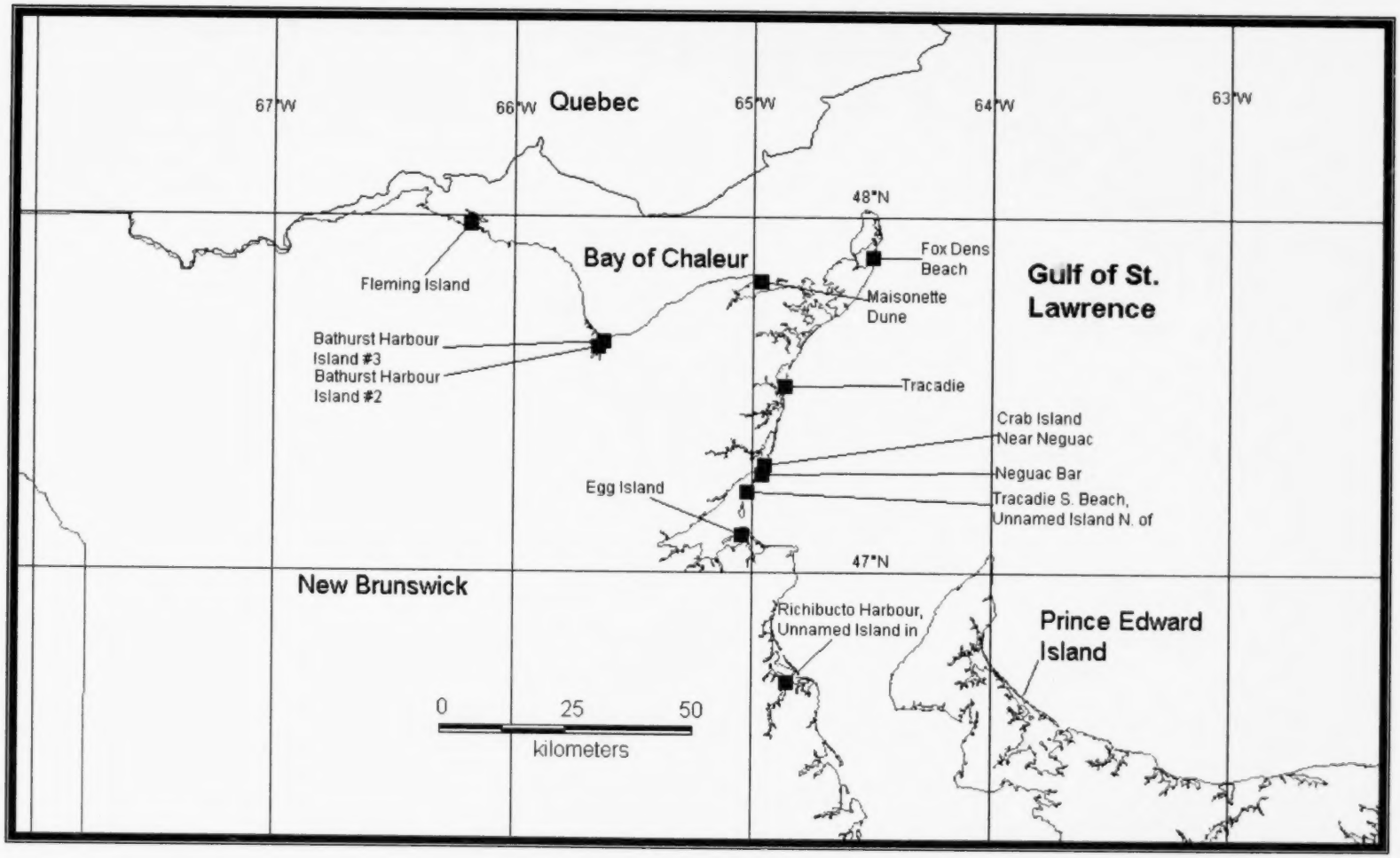

Figure 4. Location of Herring Gull colonies surveyed along the Gulf of St. Lawrence coast of New Brunswick, 2005.

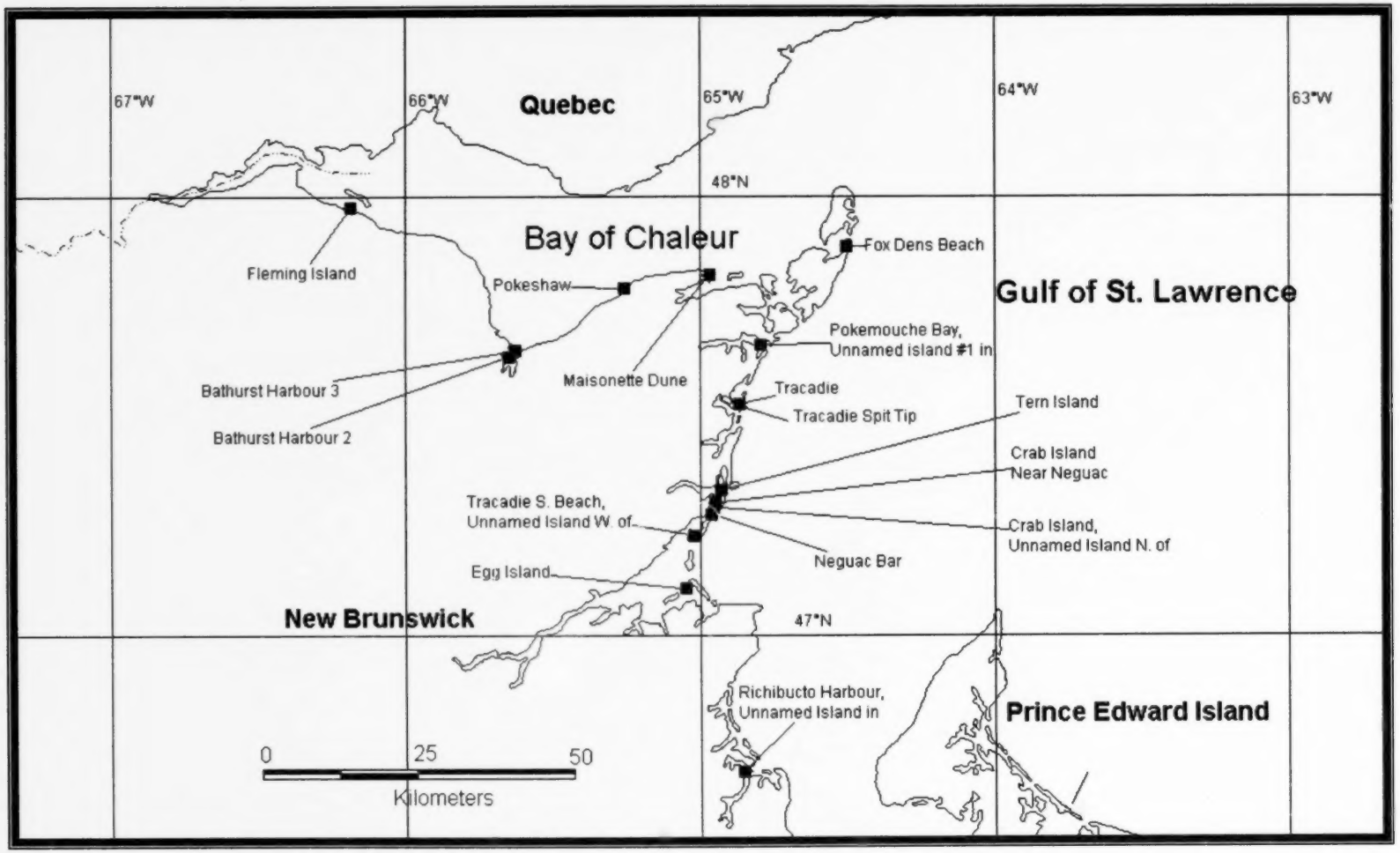

Figure 5. Location of Great Black-backed Gull colonies surveyed along the Gulf of St. Lawrence coast of New Brunswick, 2005.

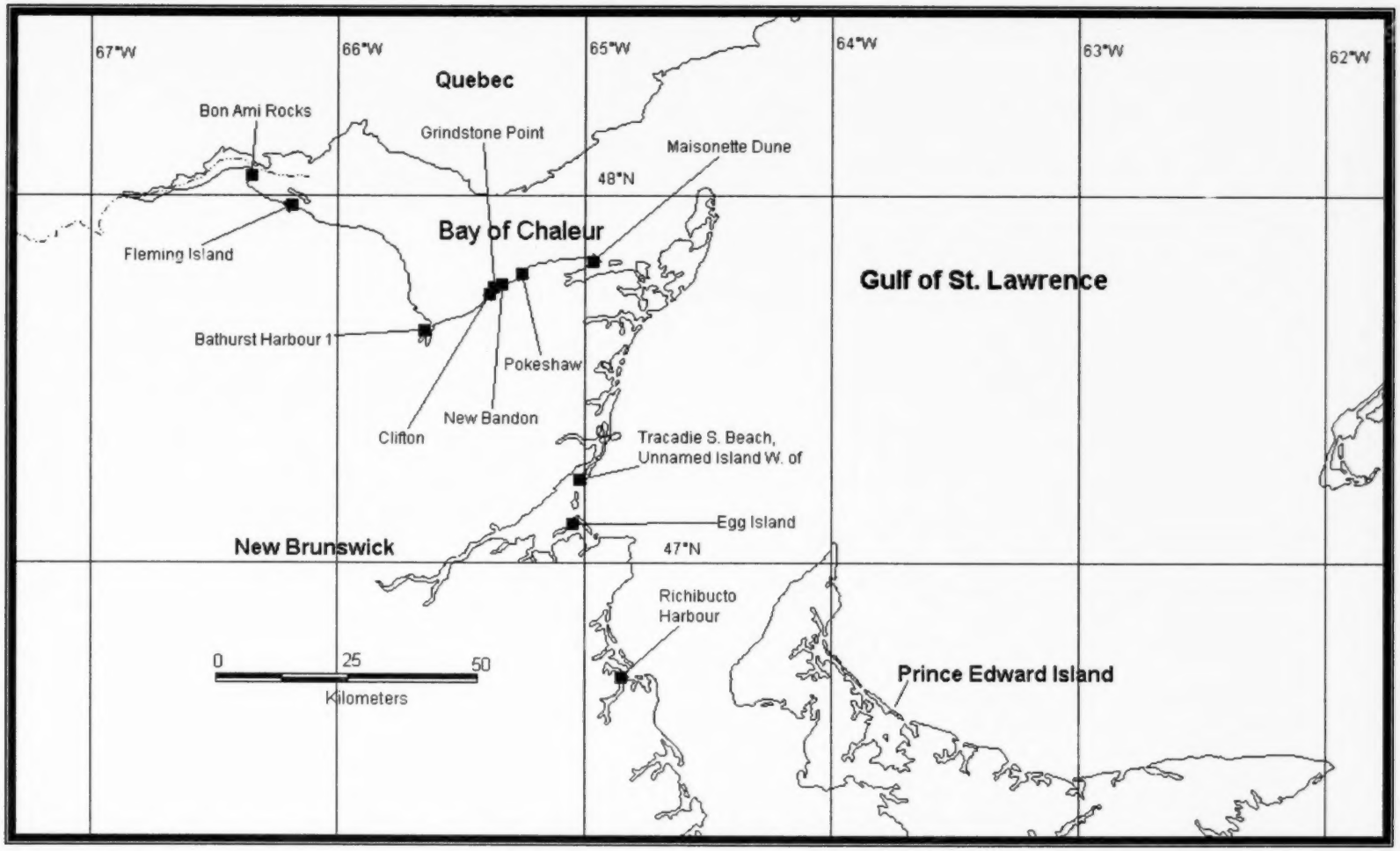

Figure 6. Location of Double-crested Cormorant colonies surveyed along the Gulf of St. Lawrence coast of New Brunswick, 2005.

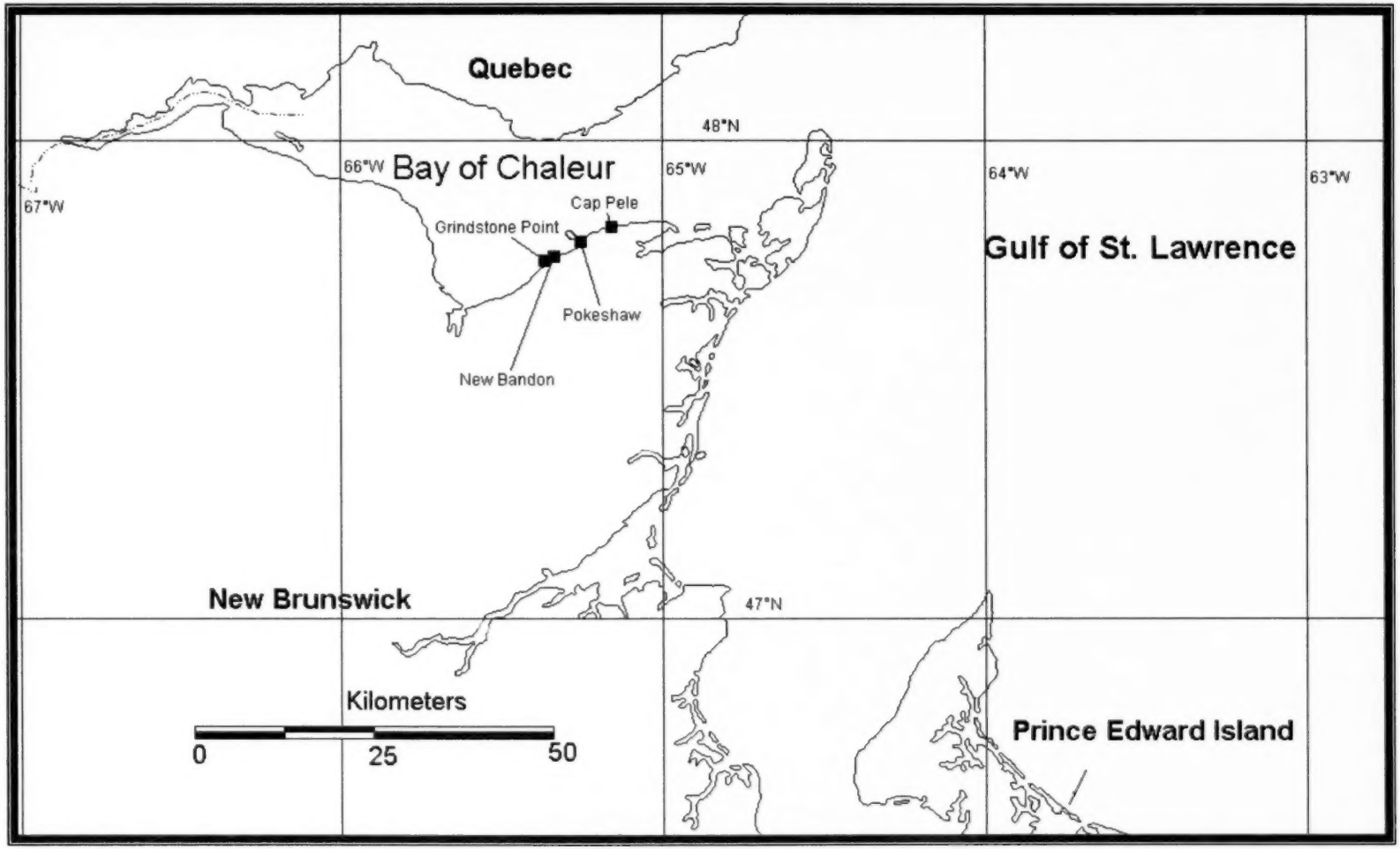

Figure 7. Locations of Black-legged Kittiwake colonies surveyed along the Gulf of St. Lawrence coast of New Brunswick, 2005.

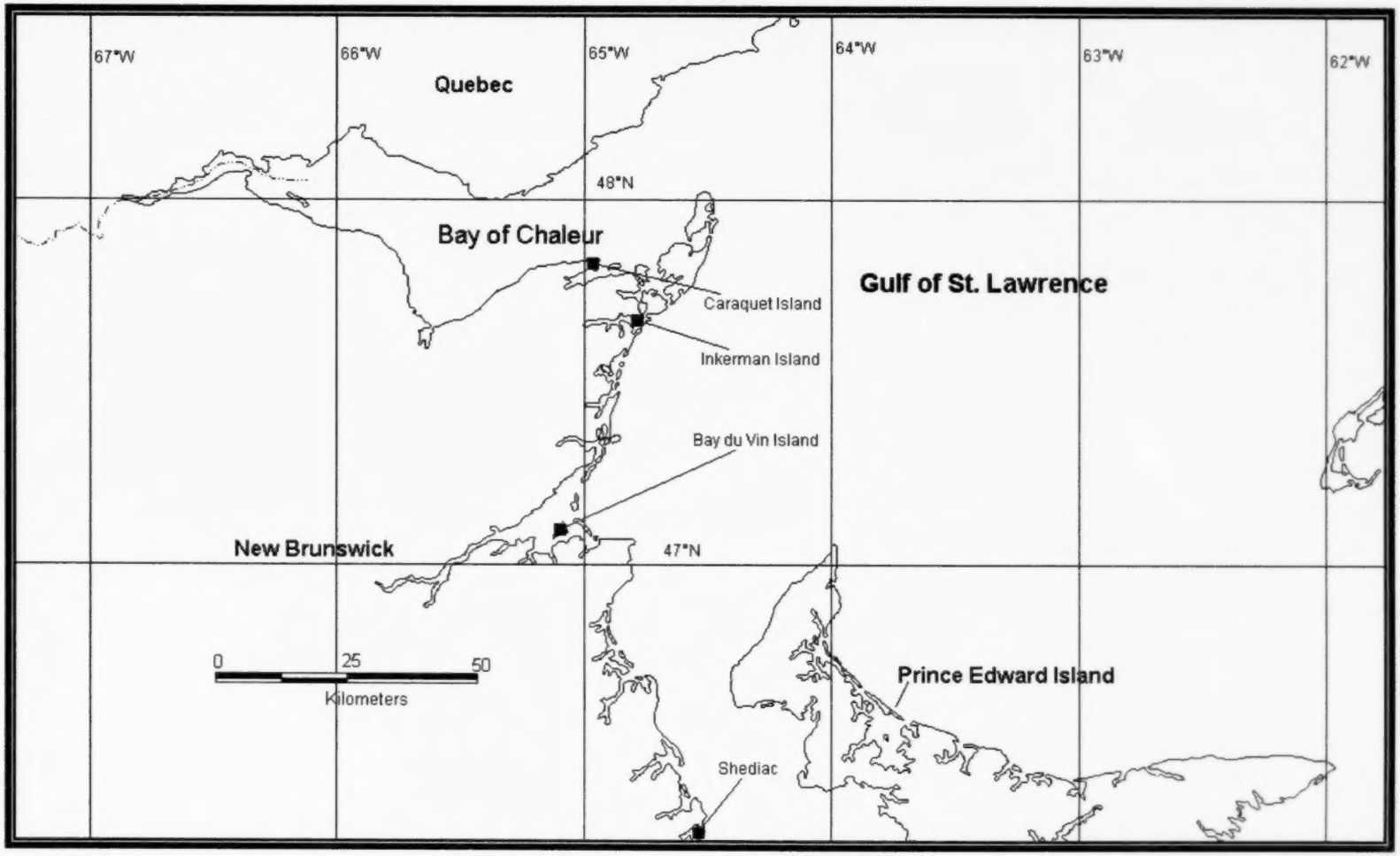

Figure 8. Location of Great Blue Heron colonies surveyed along the Gulf of St. Lawrence coast of New Brunswick, 2005.